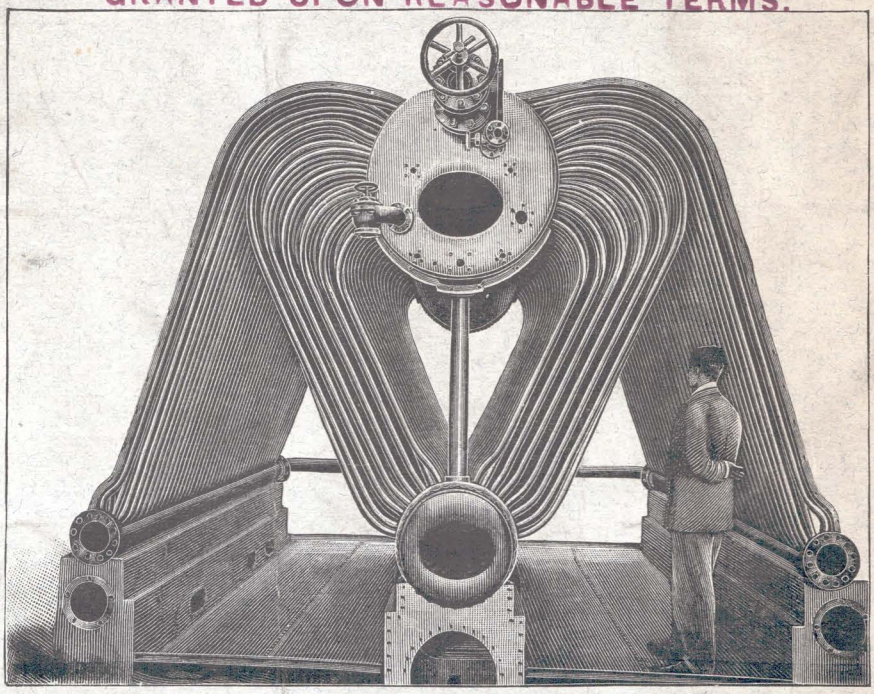
1908

THE

"THORNYCROFT"

WATER-TUBE BOILERS.

LICENSES TO MANUFACTURE WILL BE GRANTED UPON REASONABLE TERMS.



"DARING" TYPE.

Sole Agents for the United States of America—

MESSRS. JOHN PLATT & CO.,

Consulting Engineers,

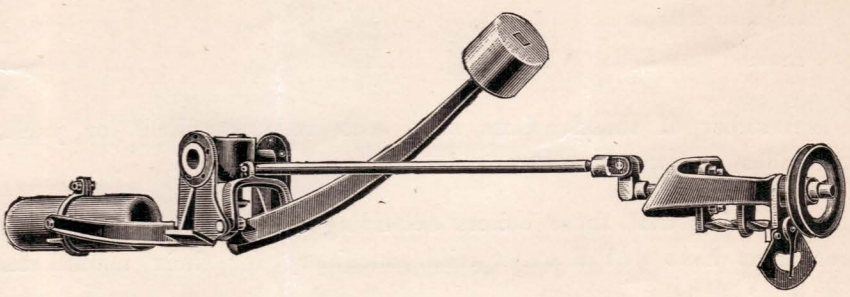
FIDELITY BUILDINGS, 97 TO 103, CEDAR STREET, NEW YORK.

THE

"THORNYCROFT"

WATER-TUBE BOILERS.

Total Horse-power over 200,000.



THE "THORNYCROFT" AUTOMATIC FEED REGULATOR.

LONDON:

PRINTED AT THE BEDFORD PRESS, 20 AND 21, BEDFORDBURY, STRAND, W.C.

"THORNYCROFT" WATER-TUBE BOILERS

are in use in the following classes of vessels:—

Name of Government.	Class of Vessel.
Great Britain	Cruisers
,, ...	Torpedo-Gunboats
,, ...	Torpedo-Boat Destroyers
,, ...	Torpedo-Boats
India	Torpedo-Boats
France	,, ,,
Germany...	Ironclads
,, ...	Torpedo-Boats
Denmark	Cruisers
,, ...	Patrol Boats
,, ...	Torpedo-Boats
Austria	,, ,,
Spain	,, ,,
Italy	,, ,,
United States of America	,, ,,
Argentine Republic	,, ,,
Brazil	,, ,,

A number of these boilers have also been supplied for yachts, &c., besides a few at work on land.

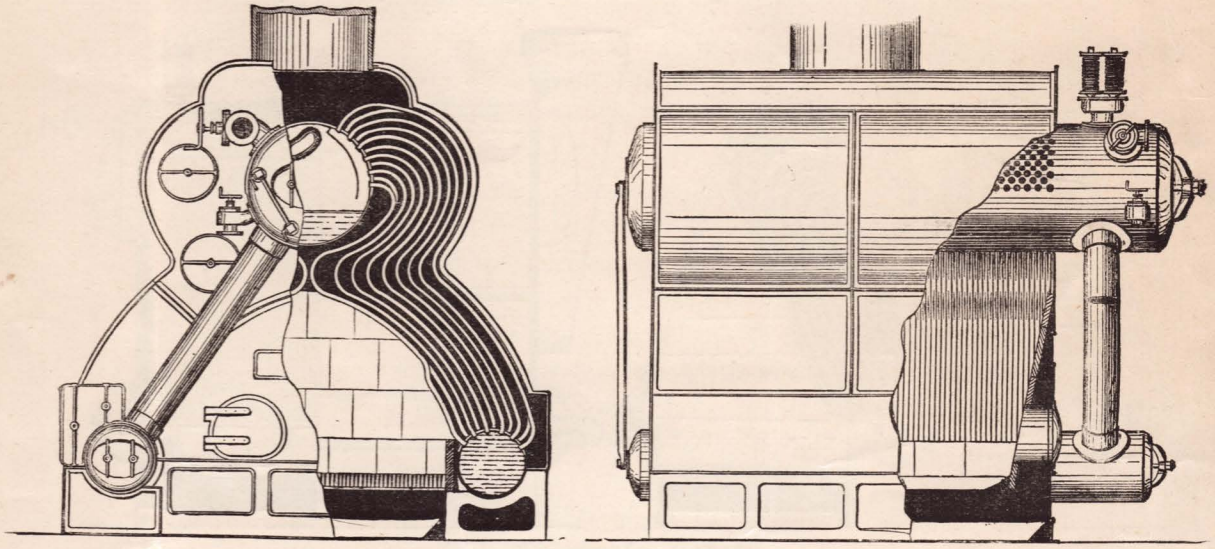
After trials with these boilers extending over 10 years, the British Government have put down special machinery for their manufacture on a large scale.

After very extensive experience with the **Thornycroft Boilers,** the Government of Denmark has also taken up their manufacture for the Royal Danish Navy.

They have been built in considerable numbers in France, Germany, America, &c., under license from **Messrs. J. I. Thornycroft & Co.,** the total number of boilers now at work or building representing an aggregate of over **200,000** indicated horse-power.

THE "THORNYCROFT" WATER-TUBE BOILERS.

IN the early days of the Steam Engine, when pressures below that of the atmosphere were common, the chief point dwelt upon in considering the strength of a steam boiler was, whether it would collapse or not. As the qualities leading to economy became better understood, the steam



H.M.S. "SPEEDY" TYPE.

pressures in use became higher and higher, till at 160 to 180 pounds per square inch, the practical limit of pressure with the boilers then in vogue was reached. A few cylindrical boilers have been constructed to stand as much as 200 pounds pressure per square inch, but these are exceptional, and owing to their necessarily very thick plates, great care has to be exercised in lighting up the fires, to avoid too rapid local expansion.

Some years ago Messrs. J. I. Thornycroft and Co. introduced a Water-tube Boiler of what is now known as the "Speedy" type,* which

* A still earlier example of a boiler embodying the principle of the later types of "Thornycroft" boilers is still at work in Africa. It was described and illustrated in "ENGINEERING," vol. xxxv., page 463, and in "Proceedings of the Institution of Civil Engineers," vol. lxxviii., page 405.

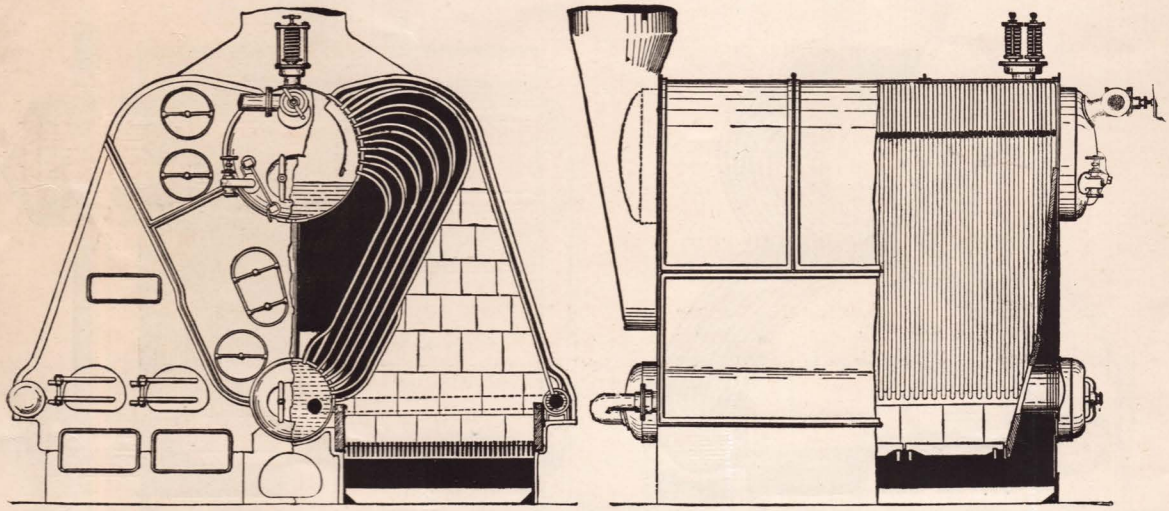
was intended to do away with the many disadvantages of the boilers then in use in the Navy, where forced draught and higher pressures had to be used, and where light weight was of the utmost importance.

The following qualities, among others, are claimed for the "Thornycroft" boilers:—

Their weight is small.

They are well adapted for steam pressures up to 300 pounds per square inch or more.

Steam is raised in 20 or 30 minutes, or even more quickly if desired, without leakage at the tube joints or straining from irregular expansion.



H.M.S. "DARING" TYPE.

They last well.

They are by far the safest boilers known. If, by long usage, a tube *should* give way, the damage to life and property is less than half what it is with the common water-tube boilers in which the steam generating tubes discharge their contents below the water-line. In this event the necessary repairs, before again getting under weigh, occupy only a short space of time.

Since the upper ends of the steam-generating tubes terminate above the water-line, they cannot become choked by dirt or scale (or bolts, &c., left in the upper barrel through carelessness after repairs)—a risk which is always present with water-tube boilers in which the tubes end below the water line.

Their flues are easy to clean, and worn out tubes can readily be replaced; indeed, these boilers are often built in a ship without removing a single deck plate.

They prime less than any other known type of boiler, and, when fitted with the Thornycroft automatic feed regulating gear, they are less trouble to manage.

Owing to their very roomy fire-boxes, they are exceptionally easy to stoke, and the fires are under perfect control.

The steam pressure can be quickly increased without inducing leakage or priming, and quickly lowered without the boilers giving any sort of trouble.

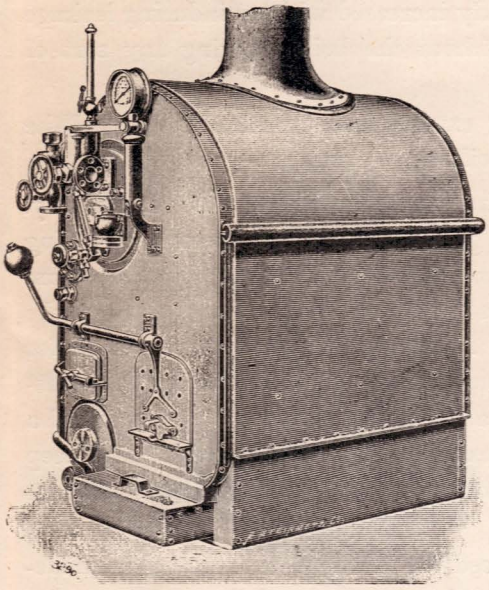
In this connection the following extract from an official report of the trials of a cruiser fitted with these boilers is of interest:—

> "During the trials the boilers worked most excellently. Steam was kept with the greatest ease; the steam generating power could be regulated nearly immediately to suit the steam consumption of the engines by means of the stop-valves on the steam pipes of the fans. At the end of the sea speed trial, for instance, we forced the engines up to 3,314 indicated horse-power in a few moments, after having steamed over seven and a half hours with an air pressure of about 0.6 in., and could keep the steam, at this high horse-power, with an air pressure of about 1 in.
>
> "When going full speed we often stopped the ship immediately, and we could bring the ship up to full speed in a few minutes, it being not necessary to take any regard whatever to the boilers, these being able to stand all sudden changes of temperature.
>
> "The boilers never primed, neither during the highest forcing nor during sudden changes in the working of the engines."

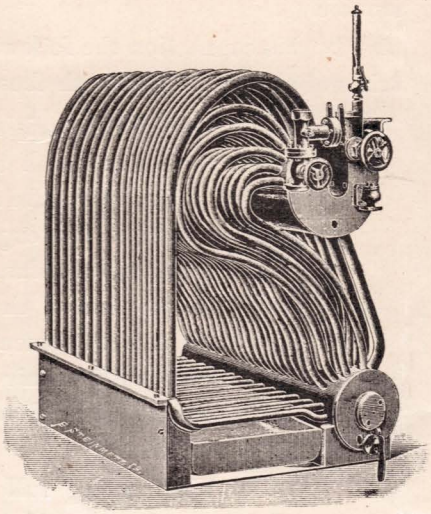
(The boilers referred to were designed for a maximum power of 3,000 indicated horse-power.)

This quality is, of course, invaluable for naval tactics. The "Speedy" type of boiler proved to be exceedingly economical and so satisfactory that a large demand quickly arose for Thornycroft boilers for all purposes, and boilers amounting in the aggregate to many thousands of horse-power have already been constructed. To meet this demand in the best way, modified

forms of these boilers have been designed having qualities specially adapted to each service. The "Daring" type of boiler has the great advantage, for large installations, that having two furnaces it is adapted to supply much more steam from a single boiler than the "Speedy" type, thus reducing the number of boilers necessary in ships of large power. It also occupies less space for a given power, and, owing to its large firegrate area, it is better adapted for working at moderate rates of combustion. The type to be used, however, is generally determined by the space available and by the position



"LAUNCH" TYPE.



"LAUNCH" TYPE (CASING REMOVED).

desired for the funnels. The third type, the Thornycroft "Launch" boiler, is strongly recommended for light river work. It is provided with water firebars, which are kept so much cooler than ordinary bars by the strong current of water rushing through them that clinkers do not adhere, and a great deal of the trouble usual in firing small boilers is eliminated. Their weight is, of course, exceedingly low, but we do not recommend this type for large boilers having wide grates. Although the circulation due to the Thornycroft principle is so intense that it is usually sufficient to prevent the adhesion of scale to the interior of the tubes, we do not recommend the use of impure water with these boilers. With pure water they work well with non-condensing engines, but they are specially

adapted for working with forced fires and condensing engines, for which they are unequalled. The three types are illustrated by the figures, in which their construction is clearly shown. It will be seen that three important features are common to all :—

1. The steam generating tubes terminate above the water-line. (This prevents the inflow of water from the top barrel, and so avoids the reversal of current which has been observed in boilers where the tubes end below the water, and which, by allowing time for bubbles to expand into large "steam chambers," is a fruitful source of overheating and danger. Statistics show that in every case where a disastrous explosion of a water-tube boiler has occurred it has been with one or other of the drowned tube types.)

2. Care is taken to provide special return tubes in which the direction of flow is constant. (Failure of many water-tube boilers may be traced to the absence of this essential condition to good circulation.).

3. Instead of allowing the gases to escape across a sort of grating of water tubes (in which case the hottest gases will be at the top, and so remain the shortest time in contact with the heating surface) flues are provided, the sides of which are formed by water tubes, and the gases are compelled to traverse the whole of the heating surface ; they are thus not allowed to escape into the chimney until they have given up a very large proportion of their heat, and as the temperature of the outside of these flue-walls cannot rise above that of the water they contain, loss by radiation is necessarily much less than in boilers where the casings are only protected by so-called non-conducting material.

These boilers have probably been subjected to a greater number of scientific experiments and more searching trials than any others, but as the limits of this pamphlet will not admit of their full description a few references must suffice.

1. Their circulation is more than double that of rival boilers. ("ENGINEERING," vol. lvii., page 399.)

2. Their circulation is always in the same direction (*Ibid*, page 399)* and hence, "steam chambers" do not form.

3. They are more economical than other boilers in Her Majesty's Navy. (*Times*, March 15, 1895.)

4. A great saving in weight and space is obtained. ("Proceedings,

* There are three misprints in the article referred to : counting from the bottom of the third column, for *alternating* (line 9) read *oscillating* ; for *together* (line 12) read *alternately* ; for *this* (line 22) read *bad water*.

Naval Architects," vol. xxxv., plate xlviii; see also "ENGINEERING," vol. xlvii, pages 402, and 412).

5. They do not explode. ("Proceedings of the Institution of Civil Engineers," vol. cxx, pages 181 and 184). Even when a tube has melted, because the feed-water was shut off and the water boiled away, no disaster occurred. ("Proceedings of the Institution of Civil Engineers," vol. cxix, page 114.)

6. Even if a tube were broken by a shot, or other cause, the danger of scalding is less than half that incurred by the use of drowned-tube boilers. ("Proceedings of the Institution of Civil Engineers," vol. cxx, page 183.)

7. As they are more and more forced their circulation increases, up to rates far beyond ordinary practice. When drowned-tube boilers are forced however, in the same way, a point is soon reached at which the water in the return tubes is so full of steam that circulation falls off, and dangerous overheating may be expected. ("ENGINEERING," vol. lviii, page 214.)

8. The principle on which their circulation depends is so perfect that even with a model occupying a space of about 1 cubic foot the efficiency proved to be identical with that of a boiler, having nearly 150 times its heating surface, which furnished steam for an engine developing over 770 indicated horse-power. ("Proceedings of the Institution of Civil Engineers," vol. cxxii, page 75.)

9. They will work with water just twice as bad as other water-tube boilers can use without priming. ("Proceedings of the Institution of Civil Engineers," vol. cxix, page 114.)

10. Professor Kennedy, after a series of careful tests of a boiler of the "Speedy" type, extending over several days, reported as follows:—"It is only right that I should say that this is the highest boiler efficiency I have ever found upon any trial with which I have had to do, if indeed it be not, as I almost think it is, the highest on record in any trustworthy manner," and he considered that Mr. Thornycroft was to be "congratulated very heartily on having produced a boiler which could not only attain such a large economy over long and rigorous trials, but so large an economy over a very wide range of work—a thing which he thought had rarely been done or even attempted." ("Proceedings of the Institute of Civil Engineers," vol. xcix, pages 61 and 74.)